Superconducting Traveling-Wave Kinetic Inductance Amplifiers for Detector Readout and Other Applications

Completed Technology Project (2017 - 2019)

Project Introduction

We propose to continue work to develop the Traveling-wave Kinetic Inductance Parametric (TKIP) amplifier, a versatile new superconducting amplifier with properties enabling a number of new instruments for astronomy that would be used in NASA missions. The main characteristics of this amplifier are exceptional sensitivity, closely approaching the limits imposed by quantum mechanics, and very broadband operation. Versions of this concept may be implemented for operation at frequencies throughout the microwave and millimeter wave bands to potentially above 1 THz with octave bandwidth. Additionally the amplifier would have a high saturation power, while dissipating very little power itself. These properties make the TKIP well suited for a number of applications in the area of detectors and detector arrays for astronomy. In the microwave band, the application we target is the multiplexed readout of detector arrays. For example, the TKIP is an ideal readout amplifier for arrays of Microwave Kinetic Inductance Detectors (MKIDs), a technology that is being vigorously pursued for large detector arrays for wavelengths from the millimeter band to X-rays. The sensitivity of these detectors is ultimately limited by the noise of the readout transistor amplifier, which is a factor of ?20 above what is achievable with the quantum-limited amplifier that we propose. The sensitivity of the TKIP amplifier would also be sufficient for a direct frequency-domain multiplexed readout for Transition Edge Sensor (TES) arrays, which could significantly improve the multiplexing factor for these detectors beyond what is achievable with current SQUID systems. For this project, we will concentrate on developing a practical microwave band version of TKIP that could be supplied to astronomical instrument builders for improving the sensitivity of MKID arrays or for TES multiplexing. We will explore the TES readout application using sensors embedded in microwave frequency resonators. Finally, we will begin to explore higher frequency operation of the TKIP by developing a W-band version of the device.

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics Research and Analysis

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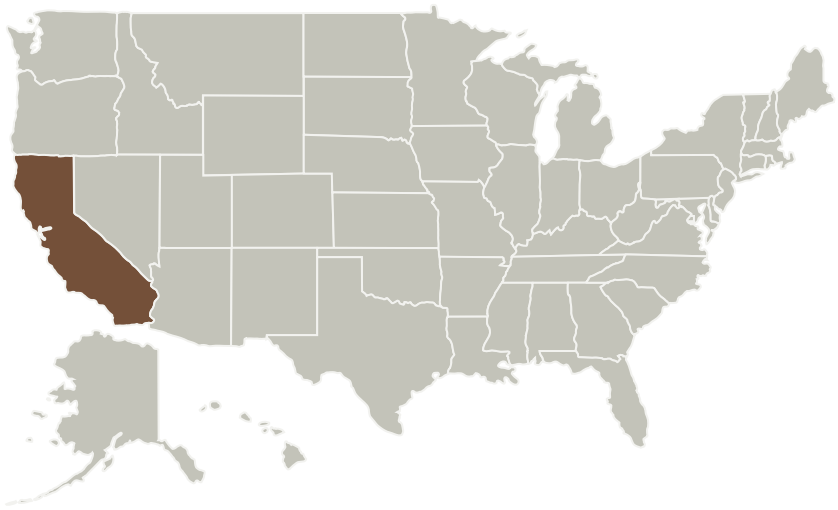
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California

Primary U.S. Work Locations
California

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Peter K Day

Co-Investigators:

Byeong Ho Eom
Henry G Leduc
Karen R Piggee
Roger C O'brient

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System